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Research and Development
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FRP Model, Version 1.0

for estimating styrene emissions from fiber-reinforced plastics fabrication processes

This user's guide is designed to help you with the installation and use of the FRP Model, Version 1.0, an empirical mathematical model to estimate styrene emissions from the manufacture of fiber-reinforced plastics/composite (FRP/C) products.

Installing the FRP Model, Version 1.0

Minimum System Requirements

- Microsoft Windows™ 95
- A personal computer using an Intel 80486 or higher microprocessor
- A minimum 4MB of internal memory
- 3.5-in. high-density (1.44 MB) disk drive
- A Video Graphics Adapter (VGA) or any other video adapter supported by Microsoft Windows ™ 95

Installation

You can run the FRP Model, Version 1.0 directly from the 3.5-in. high-density (1.44 MB) diskette or you can install it on your computer hard drive. If you decide to install it on your computer:

1. Close any open applications on your computer, make sure Windows is running, and then go to the Windows Explorer.
2. Insert the disk containing the FRP Model, Version 1.0 into drive A.
3. Create a new folder (FRP Model) on your hard drive by choosing New from the Windows Explorer File menu and then choosing Folder. Type the words FRP Model, followed by the Enter key.
4. From Windows Explorer, point and click on drive A. A folder name *Int* and the application file *FRP* will be displayed.
5. Select both the folder and the application file by holding down the shift key, pointing to each one, and clicking the left mouse button.
6. Copy them to the Clipboard by holding down the Ctrl key and hitting on the letter C.
7. Now, point to your hard drive letter (it is usually C) and click once with the left mouse button. Click on the new folder you created for the FRP Model.
8. Paste the copied folder and files by holding down the Ctrl key and hitting the letter V.
9. If you wish to make an icon of the FRP Model on your desktop, follow the instructions from your Windows User's Guide.

Using the FRP Model Version 1.0

1. Open the FRP Model, Version 1.0 program.
2. The first screen you will see is the title page for the model. Use the left mouse button to click the OK button at the bottom of the screen.
3. From the second screen , choose the appropriate process (gel coating, resin sprayup, hand layup, etc.) by clicking the left mouse button on the circle next to the process, or on the letters of the process.
4. Choosing a process will cause the "baseline" input values for that process to be displayed in both the left- and right-hand columns.

5. In the right-hand column, enter the "new values" that apply to your plant, for each of the following inputs:

   Neat resin styrene content (%, by weight). The term "neat" refers to the styrene content (by weight) of the resin before filler is added, if filler is added.

   Styrene suppressant? (Yes/No). Indicate whether the resin contains a styrene suppressant (styrene suppressants are wax additives that are added to resins to reduce styrene emissions).

   % Filler. This is the percentage (by weight) of the applied resin system that is filler. Fillers are added to resins in some lamination processes, typically to provide fire retardancy and to reduce material costs. Typical fillers are alumina trihydrate, calcium carbonate, and calcium sulfate (gypsum).

   Distance from Spray Gun to Mold (in.). This is measured as the distance traveled by the resin from the spray gun to the mold surface.

   Dry Material Off the Mold / Material Sprayed (%). This is a ratio of the material that does not land on the mold to the total material sprayed. This ratio is expressed as a percentage. Note that the amount of material off the mold is measured after it has dried (i.e. after styrene evaporation and curing), but the amount of material sprayed is measured as it leaves the gun (i.e., "wet"). These input forms allow fairly straightforward determinations for both the numerator and denominator of the ratio. In the data used to generate this model, the fiberglass "chop" was included in measurements of both the "dry material off the mold" and the "total material sprayed."

   Thickness (mils). This is the thickness in mils (i.e., thousandths of an inch) for a single spraying or laminating session, which may include 2-3 passes with the spray gun.

   Cup gel time (min). This is the gel time (in minutes) for a standard 100 mL cup gel time test. Note that this does not refer to the gel time on the part, which is typically longer than the 100 mL cup gel time.

   Application rate (lb/min). This is the application rate (in pounds per minute) of either the gel coat or the resin (in resin sprayup). In the data used to generate this model, "application rate" refers to the amount of neat resin exiting the gun per minute.

   Air temperature (EF). This is the air temperature where fabrication is occurring.

   Air velocity over the mold (ft/min). This is the average air velocity in the area between the spray gun and the mold. Air velocity over the mold can be measured with a hot wire or vane anemometer. For lamination inside a spray booth, air velocity can sometimes be calculated (approximated) using the spray booth flow rate, and the cross-sectional areas of the booth and the part.

6. After all parameters appropriate to your fabrication process have been added, click on the "Calculate" button. This will cause the values for "Overall modification factor" and "Calculated emission (% AS)" to be displayed in the bottom-right-hand corner of the screen. "Calculated emission (%AS)" represents the calculated emission factor (as a percentage of available styrene) under the conditions at your facility.

7. If you wish to see the individual modification factors calculated for each individual input to the model, go to the icons at the top-left-hand corner of the page. Find the icon with the small blue header, titled "list modification factors." Using the left mouse button to click on this icon will display a "list of modification factors" with each modification factor as it applies to the process conditions you have input. After this list of modification factors has been displayed, close the list before performing further inputs or calculations with the model.

8. It is possible to print the list of modification factors, or the inputs and calculated results of the model. Simply click on the "print" icon, or use the "File/Print" option.

9. It is also possible to save the results of a calculation session, or to open the results of previously saved files. The files are saved using the extension ".FRP."

10. At the end of the session, click the left mouse button on the icon "close," or use the File/Exit sequence.

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